Habitat: Santa Rita Mts., Ariz., June 16, 19, E. A. Schwarz.

One male and one female only, the latter the larger and much the more obscure. While we have here a representation of all the markings found in the common eastern forms, all are very much obscured and the s. t. line is hardly defined at all. The femoral structure of the male is as in the other species; the antennæ are furnished with tufts of long hair and are apparently without the longer single bristles found in the other species. In the female the usual single bristles are obvious.

THE LIFE-HISTORIES OF THE NEW YORK SLUG CATERPILLARS.—(*Conclusion.*)

PLATES VI—VIII.

BY HARRISON G. DYAR, A.M., PH.D.

The life-histories of all the Eucleids* of New York listed by me (JOUR. N. Y. ENT. SOC., III, 145, 146) have now been made known with the exception of the little larva recorded as *T. testacea*. I have never seen this larva myself, and included it on Miss Morton's authority. It is, however, not *T. testacea* as Miss Morton thought, for I have raised that moth freely from other larvæ (Jour. N. Y. Ent. Soc., VI, 151). From what Miss Morton tells me, I think that she had before her the larva of Reakirt's *Kronæa minuta*. This is the only record of this species that I know of since Reakirt's time (1864); but this would seem to prove it a true inhabitant of New York. It is so rare that I doubt whether I shall find it in sufficient numbers to obtain the life history, and therefore I close this series, for the present, without it, assuming it to belong to "type 7" of the revised table given below.

*I find it necessary to revert to the old name Cochlidiidæ for this family. The consensus of opinion among lepidopterists is averse to Kirby's date of 1810? for Hübner's Tentamen, preferring 1806, and I have concluded to accept this correction. This has the effect of changing the genus *Apoda* Haw. to *Cochlidion* Hübn. The family name founded on this genus is, therefore, again valid and antedates Eucleidæ, which was used by Comstock, Neumoegen and Dyar on the basis of the old names being invalid.

Another species which has not been worked out and which is of somewhat doubtful value is *Packardia albipuncata*. I included this with some doubt, as a synonym of *P. geminata* (Jour. N. Y. Ent. Soc., VI, pp. 1 and 3); but Miss Morton told me last summer that she was now able to distinguish the larvæ and that the moths fly at different hours of the night. It is therefore probable that we have in the form a true species, though closely allied to *P. geminata*. I have not been able to obtain it in recent years, though formerly it occurred to me at Rhinebeck, N. Y.

Besides these, two other species may occur in New York, at least occasionally. Mr. Beutenmüller tells me that he remembers to have seen a specimen of *Apoda rectilinea* which was taken close to New York City and *Monoleuca semifascia* has occurred at Morris Plains, N. J. (Papilio, III, 25), which is so near to New York as to make it probable that it may occur there also. These two species are essentially southern in their distribution and New York is probably their extreme limit, if not normally beyond their limit. Therefore I shall not delay this article for them; but I hope to return to them later, and will do so if I should be so fortunate as to secure the larvæ. At the most, New York State will have twenty-one or twenty-two species of Eucleidæ, the larvæ of eighteen of which have now been made known in all their stages in this series of articles. The three species not yet known are included in the genealogical tree in their probable positions, but are not represented as attached to the main stem. (Plate VI, Fig. 6, *i*, *t* and *q*.)

Summary of Structural Characters.

The eggs of all our species are alike, elliptical, flat and very thin, colorless and reticulated, except *Phobetron pithecium*, which differs in being circular and brown. Some of the eggs are yellow or almost orange color, but *Phobetron* is the darkest. They hatch in periods varying from seven to ten days, rarely fifteen days. The larvæ comprise several structural types whose relations may be briefly defined by the following

Revised Synoptic Table.

Section 1. (Tropic hairy Eucleids).—Larvæ hairy; subventral space somewhat reduced; tubercles produced into horn-like appendages, fleshy and more or less deciduous, bearing many setæ; spiracle on joint 5 higher up than the others and the tubercle above it.

absent; three tubercles on the mesothoracic segment. Primitive first stage present: tubercles I and II completely united.

Type 1.—Three tubercles on last two thoracic segments; subdorsal horns of joints 4 to 12 functional, the rest and the lateral horns reduced; horns deciduous.

Horns irregular at maturity; setæ of many kinds; color dead-leaf brown. **Phobetron pithecium.**

Horns regular at maturity; setæ of several kinds; color green.* (Plate VI, fig. 6 D, upper.) ..... **Isochætes beutenmulleri.**

Type 1a.—Only two tubercles on the last thoracic segment; subdorsal horns of joints 3 to 13 functional, the laterals reduced to hairless papillæ; horns not normally deciduous, but detachable.

Horns regular at maturity; setæ of several kinds; color green with red marks.* (Plate VI, fig. 6 D, lower.) ..... **Alarodia slossoniæ.**

Section 2. (Tropic spined Eucleids.)—Larvæ spiny; subventral space reduced; tubercles horn-like, firmly attached and never deciduous, of varying length, bearing stinging spinules; spiracle on joint 5 moved upward, the lateral tubercle of this joint absent; only two tubercles on the thoracic segments. No primitive first stage; the horns with several non-spinous setæ in stage I.

Type 2.—More than three setæ on the horns in stage I or on some of them; horns subequal, short; no detachable spinules at maturity.

Shape normal; subdorsal horns bent outward, but erectile; skin granular at maturity; green, horns red tipped, dorsum and sides marked with irregular yellow lines..... **Nadata nasoni.**

Shape flattened, dorsal space reduced; subdorsal horns shortened, slender, nonfunctional; skin marked with waved ridges; green with yellow subdorsal lines and a few small red dots centrally ..... **Sisyrosea textula.**

Type 3.—Only three setæ on each horn in stage I; subdorsal horns prominent, distinctly unequal; detachable spinules, at least the "caltropes" always present at maturity.

Horn of joint 8 longer than the adjoining ones in stage I and often throughout all the stages.

Without patches of detachable spines between the terminal horns.

Subdorsal horns of joint 13 separate; horns normal.

Red or yellow with purple and white lines. **Euclea indetermina.**

Green, subdorsal band yellow; dorsum with a broad purple band, irregularly five times widened; terminal horns short. **Adoneta spinuloides.**

Green, subdorsal band yellow; dorsum with a broad purple band, irregularly five times widened; terminal horns long. (Plate VI, fig. 6 R.)†

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* This species does not occur in New York.

† Supposed to be *Monoleuca semifascia.*

Subdorsal horns of joint 13 conjoined to form a pointed tail, often produced; largest subdorsal horns erectile.

Body humped in front; dead-leaf brown with a red patch posteriorly..... **Euclea chloris.**

With detachable spines between the terminal horns in small pointed clusters.

Slightly flattened, green or purplish, variously marked with shades of red or yellow. The larvæ tend to hide by day...**Euclea delphinii.**

Horn of joint 8 not longer than the adjoining ones in stage I, those of joints 6 to 10 reduced, often obsolete; terminal detachable spinules fully developed, present in large flat patches.

Horns of joints 5 and 11 long; purple with a large green mark, white edged, squarely truncate before and with a central saddle-like spot. (Plate VI, fig. 3.)..... **Sibine stimulea.***

Section 3. (Tropic smooth Eucleids.)—Smooth larvæ; dorsal space broader than the lateral one, subventral space little reduced. Tubercles not produced, single setæ by degeneration after stage I, rudimentary; spiracles in line. No primitive first stage, the tubercles represented by small two-haired warts in stage I; no tubercles absent.

Type 4.—Lateral space absent, the two ridges conjoined, the sides formed by the large subventral area.

Depressed spaces large, plate-like, the skin granules scaled.

Green, more or less spotted with brown and yellow.

Prolimacodes scapha.

Section 4. (Palæarctic smooth Eucleids).—Smooth larvæ; dorsal and lateral spaces subequal, subventral space reduced; tubercles not produced; setæ single by degeneration, rudimentary; spiracles in line. A primitive first stage with tubercles I and II united more or less perfectly.

Type 5.—Depressed spaces small, not sharp; spines i and ii of unequal length in stage I, one reduced to a small knob on the other; joint 13 rounded quadrate; skin granules produced into secondary spines in the early stages; no dorsal red marks.

Yellowish green, no bordering dark shade to the yellow subdorsal line. Head green in stage I; skin granular shagreened beside the usual spinose granules.

Lithacodes fasciola.

Whitish green at maturity, a dark line bordering the subdorsal line; head with a black patch behind in stage I; skin smooth except for the ordinary granules.

No transverse band on joint 3; subdorsal and subventral lines free.

Cochlidion biguttata.

A transverse yellow band on joint 3 in front, joining the subventral lines.

Whitish green, subdorsal lines edged within by a blackish green

* See Can. Ent., XXIX, 77, for a table of other larvæ of this group.

broken line; skin granules single pointed..**Cochlidion y-inversa.**

Yellowish green, only slightly whitening at the end of the last stage; edge of subdorsal line red; skin granules with a crown of points till the last stage*.....**Cochlidion avellana.**

Type 6.—Depressed spaces small; tubercles i and ii almost completely united in stage I, the resulting single spine short; joint 13 produced into a pointed tail. Skin granular, not spinose nor crested at any stage; no dorsal red marks.

Well pigmented, whitish green, subdorsal line straight **Packardia geminata.**

Poorly pigmented, yellowish green; subdorsal line wavy. **Packardia elegans.**

Type 7.—Depressed spaces large, sharp; spines i and ii in stage I of about equal length, united at base, forming a Y-shaped structure; tail quadrate; skin granules not spinose; larvæ marked with red dorsally.

Skin granules with a crown of minute spines before the last stage; joint 3 with a transverse yellow band in front; dorsal red mark very small.

Anterior edge of joint 3 smooth, rounded; red mark a round spot.

Heterogenea shurtleffii.†

Joint 3 with a pair of yellow prominences in front; red mark a cross.

Kronæa minuta.‡

Skin granules more or less papillose in the early stages, not crested; no transverse yellow line on joint 3.

Dorsal red mark large, reaching the lateral margin; setæ rudimentary but persistent.

Dorsal mark twice widened, symmetrical antero-posteriorly.

Tortricidia testacea.

Dorsal mark widened, but more so posteriorly, forming a pair of excavations on the sides.....**Tortricidia pallida.**

Dorsal red mark moderate, not reaching beyond the middle of the sides; setæ absent after stage I.....**Tortricidia flexuosa.**

The cocoons and pupæ of the New York species present no marked differential characters in most cases. There is a difference in size, sometimes in color and the presence or absence of an outer veil. But many of the species are inseparable.

THE ORIGINAL EUCLEID LARVA.

A generalization of the eighteen species just worked out gives the following result: Elliptical, subcylindrical, not greatly flattened, the abdominal feet absent, replaced by a creeping disk with suckers on joints 5 to 11, possibly a small one on joint 12. Joint 2 without warts and retracted partially under joint 3, but forming a hood when

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*This species does not occur in New York. (European.) JOURN. N. Y. ENT. SOC., VII, 202.

† The European *H. cruciata* apparently differs from this in having the red mark very large, much as in *Tortricidia testacea.*

‡ Not seen. The characters are inferential from Reakirt's description.

the head is extended. On the thorax three warts; on the abdomen two on each segment with a third rudimentary subventral row reduced to two setæ (iv and v); subprimary tubercles, as well as vii and viii lost. Warts not produced, bearing hairs only after stage I, not degenerate; no stinging spines or at least these not predominant. A primitive first stage present, the tubercles i and ii united at base to form a Y-shaped structure. Spiracles in line, normal. Warts all present. Depressed spaces not present, but represented by their glandular centers at least as far as those numbered (1), (2), (4), (5) and (6); (1) paired and double on all the segments. No secondary hairs. Skin minutely spinulose or possibly finely granular. There is some evidence that the color was green, as both our present lowest species on the two sides of the tree are green. But since the above characterization fits so exactly (except for the feet) some of our sparsely haired Megalopygidæ and the whole Zygæno-Pyromorphid group in general, I should rather expect the coloration to have been like theirs, yellow with black, red or white marks.

Concerning the origin of this generalized Eucleid, it is clearly from the Megalopygidæ or their ancestors. The Megalopygidæ retain the abdominal feet, but they also have pads on joints 6 to 11, and it is these pads, extended to joint 5 and possibly 12, which I think are the homologues of the Eucleid suckers. In other respects, excluding the necessary reduction of the subventral hair structures in the Eucleid, there is absolutely no difference between my generalized Eucleid and the Megalopygid type.

CONSTRUCTION OF THE GENEALOGICAL TREE.

The larvæ divide at once into two groups, the "smooth" and the "spined," separated not only by the differences between the tendency to atrophy of the warts on the one side and hypertrophy on the other, but by the peculiar structure of joint 5 in the spined group. This represents a dichotomous division in the line of descent, and our genealogical tree will start forked (Plate VI, Fig. 6, *B* and *a*). The spined Eucleids separate into sections 1 and 2 of the revised table given above, all those on the branch F being furnished with true stinging spines and no longer feeding in stage I, which retains the ancestral setæ in reduced number. Branch G comprises this stock, but J includes those which possess detachable spinules and correspond to "type 3" of the table. Branch C is clearly the oldest, because

these species alone of the spined Eucleids retain the middle thoracic wart and possess a primitive first stage, all as in the smooth Eucleids on branch a. At F it is probable that bright "warning" colors became prominent along with the development of true stinging spines. At present these are well retained only in two species, *Euclea indetermina* and *Sibine stimulea*, and these two are the only ones that are strongly urticating to the touch.

The smooth Eucleids present the two very different types described in sections 3 and 4 of the table. The first is represented by but a single species in our territory, and no other is at present well known to me. Consequently I cannot decide positively which are the specific and which the congenital characters in this phylum, the more so as our species is highly specialized. Yet it is most important, for it retains warts in its first stage, thus showing that the smooth Eucleids are descended from wart-bearing ancestors. The other group (Fig. 6, *c*) is well represented. In this the primitive first stage is retained and the warts are completely cut out at the passage between stages I and II, which thus represents a much greater phylogenetic interval than in the otherwise more specialized *Prolimacodes scabha*. Branch c again divides at d and e on the characters of types 5 and 7 of the table. Branch e retains the forked spines of stage I, but develops the depressed spaces well; branch d specializes in stage I by the partial loss of spine ii, but retains the small, and more primitive depressed spaces. The two branches are thus about equal, representing a secondary dichotomy. The smaller branches separate on the minor characters of the sculpturing of the skin and are more fully described in the explanation of the plate below. The present will suffice to illustrate how the tree was constructed. The heights to which the specific stems are drawn shows my idea of the relative degrees of specialization.

TECHNIQUE OF LARVA RAISING.

My experience in this family may be of use to others, especially as the group is considered a difficult one. I have had the valuable assistance of Miss Emily L. Morton in first starting these studies. Although she was obliged to abandon the plan of joint authorship after the first two articles, yet the whole series is dependent upon the impetus which she gave it at first. Latterly I have been assisted by Mrs. Knopf with the drawings.

The process of finding the Eucleid larvæ differs somewhat from the usual one. In the majority of cases it is not a question of searching on a given food plant at a given season. Only two species are to be so found, *Apoda biguttata*, feeding on oak and *A. y-inversa* on hickory. Most of the species have several, or an indefinite number of food plants. The question is one of locality; first the general locality where the species occurs and next the particular position in regard to distances from the ground and conditions of light and shade. These I have tried to give under each species in the descriptions. It is scarcely ever worth while to look on rough or downy leaved trees. The Eucleids principally frequent smooth, glabrous leaves of trees and shrubs. The tree probably most attacked is the black or red oak (*Quercus coccinea*) and nearly all our species may be found on it, *A. y-inversa* of course excepted. The season of the year is here less important than usual, as the Eucleids cover a long period in their larval state. I find the month of July the best collecting season. The larvæ are then numerons, not having been devoured by their many enemies, and their small size at this time gives opportunity to observe the earlier stages. Also this season makes certain no loss of the early species, like *Tortricidia testacea*, which are often all gone at the end of August and at the same time secures at least some of the late species like *T. pallida*. I recommend the search for the eggs. Though they are probably the most difficult objects to find on the leaves with which we have to do, by a little practice it is quite possible to get them successfully. The appearance of the eggs is that of shining elliptical spots of moisture, rather than that of any ordinary lepidopterous egg. When the eggs are found the great advantage has been secured of obtaining all the life history without the trouble of rearing moths for mating. However, if mating is necessary, or becomes desirable for other reasons, a number of larvæ must be obtained. This is almost always possible, early enough in the season, by continuing the search in the same or similar locations to that where the first larvæ were found. I have found from fifteen to thirty larvæ sufficient, because the individuals of a species, if kept under proper conditions, emerge nearly simultaneously. These conditions are plenty of moisture and natural cold. I have found satisfaction in an ordinary flower pot, three-fourths full of earth in which the cocoons are placed, and covered with moss and leaves, protected by a cloth and wire screen. This is sunk in the ground to the level of the top of the pot and left out of doors from

November to the following May, when it is placed in a convenient situation, best still out of doors, but covered by a wire cage a foot high to leave the moths room to spread. I have two such cages which fit the top of the flower pot, so that one can be removed containing the emerged moths and replaced by the empty one. The treatment must be different for *Heterogenea shurtleffii*. This species normally spins in the cracks of the bark and if the cocoons are put in the flower pot they all perish. I have succeeded with a short log fastened in a wooden box with a screen top. The larvæ were allowed to spin on the log and the whole left out of doors over winter. The moths must be mated the next night after emergence; they emerge in the day time or early evening. The females of one species (*Packardia geminata*) will last two or three days and mate normally after this time, but most females begin to fly after the first night and are useless. The species of *Phobetron* and *Calybia* may be mated even after they have begun to lay infertile eggs; but the larvæ from them, even if they hatch, fail to eat or die in the earliest stages. Therefore if a male does not emerge on the same day as the female, it is necessary to attract a wild male. My mating cage is cubical, about one foot high, of green wire screen except the bottom and back, which are of wood. The back contains a large vertically hinged door, in which is a circular hole about four inches in diameter, closed by a slide. The door is used to place the female in the cage; it is large enough to admit the screen from the flower pot. The cage is then left in the woods where the moths are known to be, with the back towards a tree or some other shadow, the front facing the wind and the slide open. I leave it thus all night. As the moths fly toward the light the female does not pass out through the slide, yet the male finds access, perceiving the odor of the female which passes from the back of the cage with the wind. The male is also retained in the cage, even if the pair separate before morning. I find this method easier and I believe quite as satisfactory as sitting up with or without a lamp to catch the males to insert in the cage (See Ent. News, III, 3). The female may be removed from the cage on the following evening and placed in a glass jelly tumbler with tight fitting tin top with one or more leaves. The eggs will be readily deposited over the leaves and glass. In raising the larvæ the following points are to be noted: The eggs must be kept slightly moist, as by keeping the tumbler in which they are laid closed, with a drop of water now and then if the leaves tend to dry. When the larvæ hatch

the leaves are no longer fit to eat and the larvæ must be at once transferred to fresh leaves with a moist camel's hair brush, as they will not walk to the leaves themselves. The jar containing the larvæ should be cleaned every day, but the leaves will keep from three to six days if the conditions of moisture are properly attended to. When a little grown, the larvæ will move themselves to the fresh leaves. The Eucleid larvæ are hardy, and if attended to properly and not unduly crowded, grow up nicely in closed jars. Some patience is required, as their period of growth usually takes two months. In raising large numbers of one species it will be found useful to place them on the growing tree, covered with a large bag of cheese cloth. This method is often attended with great loss from the accidental inclusion of parasites, chiefly the predaceous *Hemiptera*, which as eggs easily escape observation. I have lost a whole bag full of larvæ from placing them in a bad location where the heat was too intense. Therefore I do not recommend the method except for numbers of larvæ too large to handle in tumblers.

Generic Revision of the North American Eucleids (Cochlidiidæ).

Assuming my genealogical tree to represent the actual phylogeny of the Cochlidiidæ, we may prepare a generic revision of the family, using as primary characters those imaginal ones that correspond to the large branches of the tree, and as secondary ones those corresponding to the smaller branches. This will serve also to test the relative phylogenetic value of the ordinary generic characters as used in this family. Beginning with those that prove the more fundamental, we have:

The character is gained once in phylogeny.

1. The antennæ of the male were originally pectinated to the tip. In branch *a* they have become simple; in branch B they remain pectinate, but at branch J the pectinations are restricted to the basal portion, the tips becoming simple.

2. The labial palpi * may have been originally short and porrect, but exceeding the frontal tuft. At branch *a* the character is exaggerated, at least never lessened; but at branch C they are shortened, not reaching beyond the frontal tuft.

* Not including *Isochætes*, which adds another exception in both palpi and tibial spurs.

3. The weak discal vein (Media) dividing the cell is forked at tip, the fork forming the closure of the cell, short and open. At branch J it becomes long and closed without, more or less distinctly, by a cross vein.

4. The fore wings have twelve veins, but at stem O–R vein 8 has disappeared.

The character is gained twice in phylogeny.

1. The palpi* may have been short and porrect, not reaching vertex of head. At branch *a* they become elongated, upturned, reaching vertex of head, or extending above it in branch *m* (coincident with the loss of the pectination of antennæ); but at *g* they are shortened again, not reaching vertex of head and porrect. Branch B retains the primitive short palpi, except at I, where there is a slight lengthening with upturning, but not so as to approach vertex of head.

2. Vein 6 of hind wings arose from the cross vein of cell, separate from vein 8. At branch B vein 6 becomes coincident with 7 at origin or stalked with it; also at branch *b*. Branch *c* retains the primitive character.

The character is gained thrice in phylogeny.

1. Vein 7 of the fore wings arose from the cell, remote from the stalk of 8 and 9. It has become united with this stalk, either arising from its base or at a varying distance along the stalk in branches C, I and J. Branches *b* and *c* retain the primitive character.

2. The hind tibiæ* had two pairs of spurs, at the middle and end of the tibiæ respectively. The middle pair of these has been lost at branches I, J and *g*.

The character is gained six times in phylogeny.

Vein 10 of fore wings arose from the cell, before the origin of the stalk of veins 8 and 9. It has become coincident with this stalk for varying distances at branches Q, M–N, I, C, *b* and *f*. This character seems too flexible to be of use in generic definition.

SYNOPSIS OF GENERA.

Male antennæ pectinate at least in part.

Palpi, long, upturned nearly to vertex..... .....**Isochætes.**†

* Not including *Isochætes*, which adds another exception in both palpi and tibial spurs.

† This genus was unknown to me when this article was prepared and has been inserted in the proof. The larva belongs definitely to the *Phobetron* group (Tropic hairy Eucleids), yet the imago contradicts the character that I had selected as defining

Palpi short, not reaching beyond frontal tuft.
Head sunken.....**Phobetron.**
Head subprominent.....**Alarodia.**
Palpi longer, reaching distinctly beyond frontal tuft, not to vertex.
Media of fore wings short-forked and open; male antennæ pectinated to tip.
Vein 7 of fore wings from cell; four spurs on hind tibiæ.....**Natada.**
Vein 7 stalked; two spurs on hind tibiæ.....**Sisyrosea.**
Media of fore wings long-forked and more or less distinctly closed by a cross vein; male antennæ simple towards the tip; two spurs on hind tibiæ.
Interior margin of fore wings straight.
Fore wings with all veins present.
Vein 10 usually from the cell.....**Parasa.**
Vein 10 stalked.....**Euclea.**
Fore wing with eleven veins (vein 8 absent).
Exterior margin of fore wings entire.....**Monoleuca.**
Exterior margin slightly excavate below apex.....**Adoneta.**
Interior margin of fore wings sinuate; excavated before anal angle, **Sibine.**

Male antennæ simple.
Vein 6 of hind wings stalked with 7.....**Prolimacodes.**
Vein 6 of hind wings from the cell.
Palpi reaching vertex of head.
Costa nearly straight; fore wing rather square at apex; vein 10 from the cell.....**Cochlidion.**
Fore wing broader, more rounded; costa arched; vein 10 from the cell.....**Packardia.**
Fore wing more pointed, costa arched, vein 10 usually stalked. **Tortricidia.**
Palpi reaching above vertex of head.....**Lithacodes.**
Palpi not reaching over half way to vertex of head: only two spurs on hind tibiæ.....**Heterogenea.**

Genus **Phobetron** *Hübner.*

1816. *Phobetron* HUBNER, Verz. bek. Schmett. 398.
1841. *Ecnomidea* WESTWOOD, Nat. Lib. Exot. Moths, 183.
1855. *Euryda* HERRICH-SCHÄFFER, Ausser. Schmett. I, 7.
1855. *Nemeta* WALKER, Cat. Brit. Mus. IV, 968.
1864. *Phobetrum* PACKARD, Proc. Ent. Soc. Phil. III, 340.
1892. *Phobetrum* KIRBY, Cat. Lep. Het. I, 535.
1894. *Phobetron* NEUMOEGEN AND DYAR, Journ. N. Y. Ent. Soc. II, 66.
Type, *pithecium* Abb. & Smith.

Species: *pithecium* Abb. & Sm. (New York slug caterpillars, V).

this group, and at the moment of writing I am not able to supply another. It is curious that from imaginal characters the lower members of the Tropic Spined Eucleids (*Natada* and *Sisyrosea*) seem almost strictly referable to the preceding group (Tropic hairy Eucleids).

Genus **Isochætes** *Dyar.*

1899. *Isochætes*, DYAR, Journ. N. Y. Ent. Soc. VII, 208.
Type and species, *beutenmülleri* Hy. Ed.

Genus **Alarodia** *Möschler.*

1865. *Phyrne* GROTE, Proc. Ent. Soc. Phil. V, 246.
1886. *Alarodia* MÖSCHLER, Abh. Senek. Ges. XIV, 3 Heft, 35.
1892. *Calybia* KIRBY, Cat. Lep. Het. I, 446.
1893. *Eupoeya* PACKARD, Ent. News, IV, 169.
1897. *Calybia* DYAR, Journ. N. Y. Ent. Soc. V, 121.
Type, *nana* MöschI.

Möschler describes the palpi of *Alarodia* as "dunn," which is not as explicit as could be desired; otherwise his description fits the forms heretofore grouped as *Calybia*. I have not seen *nana* in nature, but think I am correct in the present reference, especially as the pattern of coloration of *nana* fits in well here.

Species: *slossoniæ* Pack. (Journ. N. Y. Ent. Soc., Sept., 1897, and Sept., 1898).

Genus **Natada** *Walker.*

1855. *Natada* WALKER, Cat. Brit. Mus. V, 1108.
1858. *Phlossia* WALKER, Cat. Brit. Mus. XV, 1673.
1892. *Natada* KIRBY, Cap. Lep. Het. I, 541.
1892. *Natada* HAMPSON, Moths of India, I, 380.
Type, *rufescens* WALK.

Species: *nasoni* Grote. (New York slug caterpillars, XVIII.)

Genus **Sisyrosea** *Grote.*

1864. ‖*Isa* PACKARD, Proc. Ent. Soc. Phil. III, 347.
1876. *Sisyrosea* GROTE, Can. Ent. VIII, 112.
1891. *Isa* DYAR, Ent. News, II, 156
1892. *Sosiosa* KIRBY, Cat. Lep. Het. I, 551.
1894. *Sisyrosea* NEUMOEGEN & DYAR, Journ. N. Y. Ent. Soc. II, 66.
Type, *textula* H.-S.

Species: *textula* H.-S. (New York slug caterpillars, VI.)

Genus **Euclea** *Hübn.*

1816. *Euclea* HÜBNER, Verz. bek. Schmett., 149.
1854. ‖*Neæra* HERRICH-SCHÄFFER, Samml. Ausser. Schmett. I, fig. 176.
1859. *Parasa* MOORE, Cat. Lep. E. I. Co. 413.
1860. *Nochelia* CLEMENS, Proc. Acad. Nat. Sci. Phil. XII, 159.
1864. *Callochlora* PACKARD, Proc. Ent. Soc. Phil. III, 339.
1892. *Euclea* KIRBY, Cat. Lep. Het. I, 547.
1892. *Parasa* HAMPSON, Moths of India, I, 387.
1894. *Euclea* NEUMOEGEN & DYAR, Journ. N. Y. Ent. Soc. II, 66.
Type, *cippus* CRAM.

I have not seen this type in nature. The characters are taken from the apparently very closely allied *delphinii*. I have shown above that the origin of vein ten of fore-wings is not a good generic character; hence it seems necessary to unite *Euclea* with *Parasa*. *Euclea* is the higher form with more rounded wings and reduced green markings, but the characters intergrade and the two series do not seem sharply separable. The larva of our *Parasa chloris* is unusually specialized. Indian species of *Parasa* retain the older type of larva.

Species: *delphinii* Bd. (New York slug caterpillars, X), *nanina* Dyar,* *incisa* Harv., *indeterminina* Bd.' (New York slug caterpillars, IX), *chloris* H.-S. (New York slug caterpillars, XI).

Genus **Monoleuca** *Grt. & Rob.*

1869. *Monoleuca* Grote & Robinson, Trans. Am. Ent. Soc. II, 187.
1894. *Monoleuca* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 69.
Type, *semifascia* Walk.

Species: *subdentosa* Dyar, *semifascia* Walk., *sulfurea* Grote, *obliqua* Hy. Edw.

Genus **Adoneta** *Clem.*

1860. *Adoneta* Clemens, Proc. Acad. Nat. Sci. Phil. XII, 158.
1864. ‖*Cyclopteryx* Packard, Proc. Ent. Soc. Phil. III, 344.
1894. *Adoneta* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 69.
Type, *spinuloides* H.-S.

Species: *spinuloides* H.-S. (New York Slug Caterpillars, VIII), ? *leucosigma* Pack., ? *pygmæa* Grt. & Rob.

Genus **Sibine** *H-S.*

1855. *Sibine* Herrich-Schäffer, Ausser. Schmett. I, 7.
1855. ‖*Xyssia* Walker, Cat. Brit. Mus. V, 1132.
1860. *Empretia* Clemens, Proc. Acad. Nat. Sci. Phil. XII, 158.
1866. *Eupalia* Walker, Cat. Brit. Mus. XXXV, 1927.
1878. ‖*Streblota* Berg, Ann. Soc. Argent. V, 177.
1878. *Neomiresa* Butler, Trans. Ent. Soc. Lond. 74.
1887. *Eupalia* Druce, Biol. Cent.-Am. Lep. I, 217.
1892. *Sibine* Kirby, Cat. Lep. Het. I, 539.
1894. *Sibine* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 72.
Type, *nesea* Stoll.

Species: *stimulea* Clem. (New York Slug Caterpillars, II).

* There is already a *Euclea nana* of Herrich-Schäffer, a species of Lacosomidæ. This is not the *Euclea* of Hübner, and Kirby makes the species a synonym of *Pamea albistriga* Walk.; but the name has existed, so I change the name of my species.

Genus **Prolimacodes** *Schaus.*

1896. *Prolimacodes* SCHAUS, Journ. N. Y. Ent. Soc. IV, 56.
Type, *triangulifera* Schaus.

Mr. Schaus separated the type generically from *scapha* on the position of vein 10 of fore-wings, which I have shown above to be a valueless distinction. It so happens that Mr. Schaus' fortunately chosen and appropriate name may be retained. I had noticed that Möschler's description of *Eulimacodes* contradicted *scapha* in important characters. Recently Mr. Schaus has kindly loaned me considerable carefully named material that proves Möschler's genus a synonym of *Semyra* Walk, thus leaving the *scapha* type unnamed.

Species: *scapha* Harris (New York slug caterpillars, IV), *trigona* Hy. Edw.

Genus **Cochlidion** *Hübn.*

1806. *Cochlidion* HÜBNER, Tentamen, 2.
1809. *Apoda* HAWORTH, Lep. Brit. II, 137.
1816. *Chelonias* HÜBNER, Verz. bek. Schmett. 398.
1825. *Limacodes* LATREILLE, Fam. Nat. 474.
1877. *Phrixolepia* BUTLER, Ann. Nat. Hist. (4) XX, 475.
1892. *Apoda* KIRBY, Cat. Lep. Het. I, 552.
1895. *Apoda* MEYRICK, Hand. Brit. Lep. 451.
Type, *avellana* Linn.

Species: *biguttata* Pack. (New York Slug Caterpillars, XII), *rectilinea* Grt. & Rob., *y-inversa* Pack. (New York slug caterpillars, I).

Genus **Packardia** *Grt. & Rob.*

1864. ‖*Cyrtosia* PACKARD, Proc. Ent. Soc. Phil. III, 342.
1866 *Packardia* GROTE & ROBINSON, Ann. Lyc. N. H. N. Y. VIII, 373.
1894. *Packardia* NEUMOEGEN & DYAR, Journ. N. Y. Ent. Soc. II, 76.
Type, *elegans* Pack.

Species: *elegans* Pack. (New York Slug Caterpillars, XIV), *geminata* Pack. (New York Slug Caterpillars, XIII). ? *albipunctata* Pack.

Genus **Tortricidia** *Pack.*

1864. *Tortricidia* PACKARD, Proc. Ent. Soc. Phil. III, 345.
1892. *Ceratonema* HAMPSON, Moths of India, I, 393.
1894. *Tortricidia* NEUMOEGEN & DYAR, Journ. N. Y. Ent. Soc. II, 75.
Type, *testacea* Pack.

Species: *testacea* Pack. (New York Slug Caterpillars, XVI), *pallida* H.-S. (New York Slug Caterpillars, III), *flexuosa* Grote (New York Slug Caterpillars, XV), *graefii* Pack, *fiskeana* Dyar.

Genus **Lithacodes** *Pack.*

1864. *Lithacodes* Packard, Proc. Ent. Soc. Phil. III, 345.
1892. *Lithacodes* Kirby, Cat. Lep. Het. I, 555.
1894. *Tortricidia* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 75.
Type, *fasciola* H.-S.

This name is given from a resemblance to the Noctuid genus *Lithacodia* Hübn., hence is not preoccupied by it.

Species: *fasciola* H.-S. (New York Slug Caterpillars, VII).

Genus **Heterogenea** *Knoch.*

1793. *Heterogenea* Knoch, Beitr. Ins. III, 60.
1829. *Heterogenea* Stephens, Ill. Brit. Ent. Haust. II, 84.
1864. ? *Kronæa* Reakirt, Proc. Ent. Soc. Phil. III, 441.
1871. *Heterogenea* Staudinger, Cat. Lep. Eur. 62.
1892. *Heterogenea* Kirby, Cat. Lep. Het. I, 556.
1894. *Heterogenea* Neumoegen & Dyar, Journ. N. Y. Ent. Soc. II, 74.
Type *cruciata* Knoch.

I have not seen *Kronæa minuta* in nature and Reakirt's description is not fully reliable. It must, therefore, remain doubtfully placed till more specimens occur. It seems nearest to this genus.

Species: *shurtleffii* Pack. (New York Slug Caterpillars XVII), ? *minuta* Reak.

Considerations Suggested by Geographical Distribution.

It is impossible to go into this subject fully at present as none of the exotic species are known in all of their stages, so I am not sure of the exact extent of the groups. However a few suggestive points appear.

The best marked group of Eucleids, geographically, is that which I have called the "palæarctic smooth Eucleids" (Psyche, VIII, 172). They are distributed in northern North America, Europe and Asia, reaching northern India. Only one species reaches South America (*Lithacodes fasciola*), but this is not a southern species, strictly speaking, for it extends as far north as any species of the family. The species of *Apoda* recorded in Kirby's catalogue from South Africa, East Indies and South America probably do not belong to this group. All of them about which there is any recent information have proved to belong in other genera. This group of Eucleids seems correlated with the former arctic continent which extended across the Atlantic, from the Jurassic to the Eocene times and was always more or less distinctly separated from the equatorial land (see Plates VII–VIII).*

* I am indebted to Professors H. F. Osborn and G. Van Ingen, of Columbia University, for information in the preparation of these maps.

The three other main groups of Eucleids seem all to have originated in the equatorial land. The problem of their distribution is less simple than that of the first group; especially the colonization of Australia offers difficulties. It would appear that these groups, and, indeed, the family itself arose in South America, or the continental mass that connected South America and Africa as late as the Jurassic (see Plates VII–VIII). But I cannot infer anything very definite. This may be largely due to the extent of our ignorance of the southern species. The Megalopygidæ, which are practically the ancestors of the Cochlidiidæ, still inhabit South America, and, according to Aurivillius, Africa also, which lends support to this view. To put the origin of the family back to the Triassic, when there may have been a continuous continental mass reaching Australia (Plates VII–VIII), would seem to give the family too early an origin, considering its highly specialized larva and the condition of the flora of that period. No fossils are known in the family, which precludes exact investigations on that basis.

EXPLANATION OF PLATE VI.

Fig. 1. *Cochlidion y-inversa*, mature larva, dorsal view, enlarged.
2. The same, last stage, but before the larva has whitened much.
3. *Sibine stimulea*, mature larva, three-quarters view, enlarged.
4. Venation of *Cochlidion y-inversa*, illustrating the short-forked discal vein.
5. Venation of *Euclea indetermina*, illustrating the long-forked discal vein.
6. Genealogical tree of the New York Slug Caterpillars.

A. The main stem represents the generalized larva described above. It has three rows of scarcely produced hairy warts, representing i + ii, iii and iv + v of abdomen, the lower row rudimentary, and ia + ib, iia + iib and iv on thorax, all three functional. A primitive first stage present, the setæ of the functional warts single, and modified so as to be represented by thick spines, which are everted on hatching; ia and ib of joint 4, i and ii of joints 5 to 12 are coalesced at base. Setæ of iv and v normal, fine, small, not everted. Paired glandular dots representing the larger depressed spaces. Weak segments 5, 7, 9 and 11, shown by the less degree of erection of the spines. Skin with minute secondary spinules. Feeds in stage I. Food plants various smooth leaves.

B. The warts remain functional and are produced (hypertrophied) especially the subdorsal row; the lateral wart of the weak segment 5 is lost, its spiracle moved up. Setæ i and ii of stage I become completely united, forming a single spine.

C. The warts become succulent and easily detached, clothed with differently modified hairs. Skin spinules converted into short secondary hairs. Depressed spaces reduced, obsolete.

D. The points of origin of the green *Probetron* allies which do not occur in New York.

E. *Phobetron pithecium.* Warts irregular, lateral row reduced, deciduous. The short horns correspond to the weak segments. Tertiary hairs replace the wart hairs, which are reduced to the primitive setæ. Color brown, like a dead leaf. Rests on top of the leaf.

F. The main stem of the spined Eucleids. Primitive first stage lost and the ability to eat in stage I also lost. First stage with horn-like warts, bearing several soft setæ. Middle wart lost on both thoracic segments. Weak segments not distinguishable. After stage I horns covered with stinging spines formed of the modified setæ. Glandular dots of depressed spaces retained, but feebly developed, the dorsal row double only on joints 3-4 and 4-5. Bright colors developed, red and yellow.

G. The lower group of spined Eucleids. Horns equal or but very slightly irregular; no detachable spinules. Stage I retains more than three setæ on the horns, at least at the extremities. Characters as in stem F, but the bright colors degenerate.

H. *Natada nasoni.* Square, horns reduced, the subdorsal row bent outward and the spines appressed to the body, but capable of erection. Skin finely granular. Color green, the horns red, the yellow lines forming a complicated pattern.

I. *Sisyrosea textula.* Flattened, horns degenerate, the subdorsal row reduced. Skin marked with curious waved ridges. Color green, horns not red except at the anterior edge.

J. Warts of stage I with three hairs only; horns irregular, the irregularity not dependent upon the weak segments; subdorsal row not shortened. Patches of "caltrope" spinules are present on the lateral horns.

K. *Sibine stimulea.* Subdorsal horn of joint 8 not longer than those of 6 to 10. Red color absent, the yellow largely replaced by green, forming a peculiar pattern on the purple ground.

L. The subdorsal horn of joint 8 not so much reduced as the others.

M. *Euclea indetermina.* Skin spinules converted into granules. Bright colors retained.

N. *Euclea delphinii.* Warts somewhat reduced; ancestral colors partly replaced by purplish and green. Skin spinules converted into granules. Terminal detachable spines present.

O. *Adoneta spinuloides.* Warts considerably reduced; ancestral colors mostly retained, but modified for concealment. Skin granular. Terminal horns short.

P. *Parasa chloris.* Warts much reduced, the larger subdorsal horns bent inward over the back, erectile; the posterior pair of horns joined,

and produced into a pointed tail. Anterior portion of body humped up. Ancestral colors replaced by a protective brown, relieved by a fiery patch posteriorly. Skin spinules converted into granules only along the subventral edge.

Q. *Monoleuca semifascia* is somewhere in this position; the larva is unknown.

R. Origin of a larva not yet bred. Terminal horns long; shape elongate, not humped. Coloration as in *Adoneta spinuloides*, but the five purple patches about equal in size.

a. The main stem of the smooth Eucleids. Differs from stem A in the tendency to reduction of the warts and increased development of the depressed spaces. Skin granular. Color green.

b. *Prolimacodes scapha*. Lateral space obliterated, a high ridge formed by the union of subdorsal and lateral ridges. Primitive first stage absent; small warts present in stage I, afterward only the primitive setæ, the warts obsolete. Depressed spaces developed into plate-like structures, the granules resembling overlapping scales. Depressed spaces (9) and (10) added. Color green, variegated with yellow and brown.

c. The main stem of the palæarctic Eucleids. Warts absent, the normal primitive setæ present after stage I. The modified primitive first stage retained with the subdorsal Y-shaped spines. Glandular dots of depressed spaces (1) united into a single center, the spaces (1) to (8) moderately developed. Skin granules somewhat spinose.

d. One limb of the Y-shaped spines of stage I reduced to a slight prominence. Depressed spaces moderate only; no red marks in the dorsal space.

e. The Y-shaped spines retained in stage I. Depressed spaces enlarged, deep, sharp edged, reducing the intervening surface to a series of latticed ridges. A red dorsal patch.

f. Skin granules discreet or subpapillose, simple.

g. Skin granules divided, forming a tuft of spines on the apex of each, simple in the last stage.

h. *Heterogenea shurtleffii*. A transverse yellow line on joint 3. Outline smooth in the last stage.

i. *Kronæa minuta*, its probable position.

j. *Tortricidia flexuosa*. Granules never papillose; setæ practically absent at first molt. Dorsal red mark moderate.

k. Granules subpapillose, setæ small, but distinct for several stages; red mark large. *T. testacea* and *T. pallida* differ only in the shape of the mark.

l. Skin granules still produced into spines.

m. *Lithacodes fasciola*. Skin shagreened granular besides the ancestral spines. Subdorsal yellow lines joined in front.

n. A patch of black pigment under the cervical shield in stage I. Whitish green, the yellow subdorsal line edged by a dark shade.

o. *Cochlidion biguttata* with the ancestral characters. Food oak.

p. *Cochlidion y-inversa.* A yellow line crosses joint 3 to join the subventral lines. Food hickory.

q. The short limb of the Y-shaped spine of stage I still more reduced than in branch **d.** One seta of the middle thoracic wart is lost. Joint 13 produced with a pointed tail in the last stage. Skin granules discreet, not spinous.

r. *Packardia geminata.* Whitish green, well pigmented.

s. *Packardia elegans.* Skin granules more numerous; yellowish green, slightly pigmented; subdorsal line wavy.

t. *Apoda rectilinea*, its probable position, the larva being unknown.

EXPLANATION OF PLATES VII–VIII.

Six maps showing the probable distribution of land and water in the Present, Eocene, Upper Cretaceous, Lower Cretaceous, Jurassic and Triassic periods respectively.

DESCRIPTION OF THE MATURE LARVA OF ACRONYCTA CONNECTA.

PLATE II, FIG. 7.

By HARRISON G. DYAR.

The description quoted in the Proceedings U. S. National Museum, XXXI, 116 is insufficient in regard to the hair structures, and has led me to place the larva wrongly in the table. It should fall in larval section II, next to *vinnula.*

Acronycta connecta Grt. *Larva.*—Head bilobed, rounded, whitish in the sutures, most of the surface dull black, shining only at the apices of the lobes; setæ white, rather long; width 3 mm. Body with low warts, scarcely at all elevated; i with a black hair and several very small ones, ii to iv, single haired, v and vi, many haired, but diffuse and confused with the rather numerous pale secondary subventral hairs. Leg plates scarcely cornified, hairy; anal plate not cornified; cervical shield bisected, concolorous with the body except for a black line that edges the inner portions of the two halves and runs a little way along the anterior edge. Body greenish white, purplish on the dorsum. A broad orange subdorsal line almost enclosing wart ii, reaching from the cervical shield to anus. Warts i and ii small, round, black; spiracles black; feet pale; no other marks.

Food-plant.—Willow. Collected by Mr. Aug. Busck at Washington, D. C., Oct. 2.